

the degree of atrophy or enlargement. At the level of the foramen magnum, intraspinal masses or masses extending intracranially are best examined by metrizamide-enhanced CT.

Finally, CT permits evaluating results of surgical operations as well as changes occurring in the spinal canal. In patients receiving radiation therapy, CT is used to define the treatment ports and to document the results of irradiation.

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### Metrizamide Myelography

IN THE SHORT TIME that metrizamide (Amipaque) has been available in this country, it has greatly changed how myelography is done. This highly versatile agent may be used with conventional filming, tomography, or computed tomography (CT) to give diagnostic information which was not readily available with isophendylate (Pantopaque).

The advantages of metrizamide stem from its physical properties. Being water-soluble, it will penetrate narrow spaces and, thus, is a better agent for outlining nerve root sleeves and spaces about tumors and for showing the spinal cord near sites of compression. The necessity of mixing the contrast agent with its diluent immediately before myelography appears inconvenient, but is advantageous in allowing the operator to tailor the concentration precisely to the desired study. The gravitational layering effect works well to fill dependent nerve root sleeves early in the study while the mixing of metrizamide with cerebrospinal fluid, which results from patient motion, can be used to outline the spinal cord in later phases of the study. Because the contrast agent need not be withdrawn, it may be injected into areas from which withdrawal would be impossible, such as in the spinal canal above a thoracic block. Arachnoiditis following the use of metrizamide is virtually unknown; therefore, this contrast agent may be used in situations in which one would hesitate to use isophendylate, such as in cases of trauma and suspected arachnoiditis.

Metrizamide also has its disadvantages. The myelography must be planned in such a way that

the contrast agent is moved gently from one region to another, avoiding excessive mixing that can rapidly dilute the agent to the point of being barely visible. Also, it may be difficult to examine the entire spinal canal without using large amounts of relatively high concentration, which increases the chances of side effects. Headache and nausea seem to be more prevalent after metrizamide myelography than after isophendylate myelography. Confusional states sometimes occur in older patients following metrizamide myelography, and coma has occurred in a few cases. The incidence of seizures shortly after myelography, originally reported to be much less than 1 in 1,000 in the European experience, is higher in the United States. This difference is probably related to the prior use in this country of isophendylate with its relatively low immediate toxicity, while European and Scandinavian myelographers were accustomed to working with aqueous contrast agents of higher toxicity, thereby developing more conservative myelographic techniques.

The combination of metrizamide and CT makes it possible to examine difficult areas using relatively low amounts and concentrations of the contrast agent, thereby decreasing the side effects. Areas where this technique is particularly helpful include the foramen magnum, cisterns about the brain stem and the suprasellar region, and investigation of syringomyelia. CT may also be used to salvage a myelographic study of the spinal canal in which the metrizamide has become too dilute for conventional filming.

Though not a perfect contrast agent, metrizamide is highly versatile and represents a significant advance over earlier myelographic contrast agents.

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### Percutaneous Transhepatic Biliary Drainage

ALTHOUGH percutaneous transhepatic biliary drainage has been used for the past decade, its use has been greatly increased since angiographic catheterization techniques were applied by Ring and co-workers. These involve placement of cath-